The Burgers Program for Fluid Dynamics

Thirteenth Annual Symposium

Wednesday, November 16, 2016
1:00 to 5:30 p.m.
Jeong H. Kim Engineering Building
Rooms 1107 & 1111

Institue for Physical Science and Technology
College of Computer, Mathematical and Natural Sciences
A. James Clark School of Engineering
University of Maryland, College Park

UNIVERSITY OF MARYLAND

Program

1:00 - 1:15

Welcoming Remarks

Jim Wallace
Director, The Burgers Program for Fluid Dynamics
Emeritus Professor, Department of Mechanical Engineering &
Insitute for Physical Science and Technology
University of Maryland

1:15 - 2:15

Burgers Lecture

Scaling Law for the Turbulent Energy Spectrum in Density-Stratified Fluids: Kolmogorov or Bolgiano-Obukhov?

Jayanta Bhattacharjee
Harsh-Chandra Research Institute
Allahabad, India

2:15 - 2:50

Simplified Fluid Mechanical Models of Human Birth

Megan Leftwich
Department of Mechanical and Aerospace Engineering
George Washington University

2:50 – 3:50

Graduate and post-doctoral poster session
with refreshments

3:50 – 4:25

Wall Modeling of Large Eddy Simulation

Johan Larsson
Department of Mechanical Engineering
University of Maryland

4:25 – 5:00

Arctic Climate Change

James Carton
Department of Atmospheric and Oceanic Science
University of Maryland

5:00 – 5:30

Reception and announcement
of best poster awards

Scaling Law for the Turbulent Energy Spectrum in Density-Stratified Fluids: Kolmogorov or Bolgiano-Obukhov?

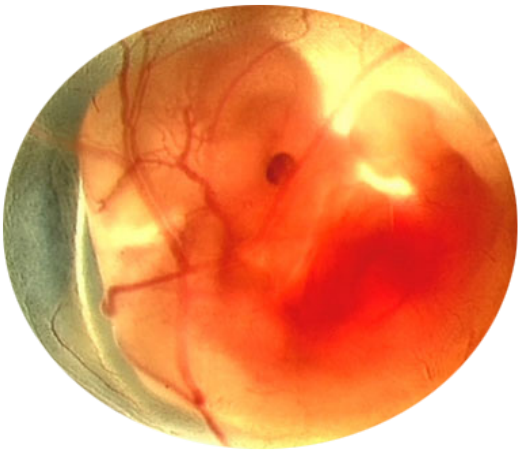
Jayanta K. Bhattacharjee

In a homogeneous isotropic turbulence, the kinetic energy spectrum is governed by the extremely well-known Kolmogorov's 5/3 law. For a density–stratified fluid (most commonly stratification produced by a thermal gradient), it was suggested by Bolgiano (and independently by Obukhov) that 5/3 could become 11/5. However, neither experiments nor simulations had observed the 11/5 exponent over a time span of decades. We will clarify under what circumstances the crossover from one to the other should occur and show that the very recent observation of the Bolgiano spectrum in numerical simulations satisfy these conditions. The relation between the form of the spectrum and the anisotropy of the velocity field will also be discussed.

Simplified Fluid Mechanical Models of Human Birth

Megan Leftwich

The laboring uterus is a complex fluid system. The pulsing, elastic boundary interacts directly with the (mostly) solid fetus and with the amniotic fluid, which aids in transferring force to the baby during labor. Additionally, there is a continuous flux of fluid in the uterus throughout. A better understanding of the mechanics of delivery may reduce the need for C-sections in less severe cases—prolonged labors and slightly abnormal fetal presentations. We are investigating this problem by considering simplified models of human birth that attempt to isolate relative force generation. Our models, both experimental and theoretical, show that changing the fluid properties alone can significantly alter the force of parturition. Furthermore, these simplified models guide us as we increase their complexity; incorporating maternal and fetal geometry and complicated force generation patterns.

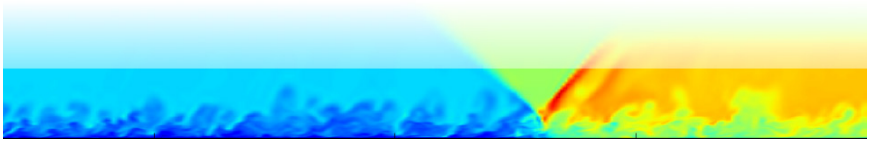


Wall-modeling in large eddy simulation

Johan Larsson

The large eddy simulation (LES) technique for turbulent flows has become a standard tool of academic research, but has yet to really make an impact on the engineering design and analysis process in more applied situations. The talk will identify a range of reasons for this situation, and will

describe recent work towards solving one of the main obstacles: the need for robust and accurate models for the turbulence in the innermost part of the boundary layer. The proposed approach to wall-modeling is based on the multi-scale nature of turbulent boundary layers and on the need for showing grid-convergence in numerical simulations. These considerations naturally lead to a number of criteria on wall-modeled LES, and a simple method that satisfies these criteria is presented. This is then shown to lead to excellent accuracy on a number of test cases, including supersonic boundary layers and shock/boundary-layer interactions.



Arctic Climate Change

James A. Carton

This past September saw Arctic sea ice extent reach a minimum 35% below the 30 year average for September. Current projections indicate this trend will continue and that by late in this century the Arctic will be essentially ice-free in summer. The reduction in sea ice cover increases the amount of solar radiation absorbed by the surface in summer leading to warmer surface ocean temperatures. These warmer ocean temperatures also contribute to the decline in sea ice extent and thickness during the following winter. In winter the reduction in sea ice cover allows the ocean to supply increasing amounts of heat and moisture to the cold, dry polar atmosphere, raising its water content and affecting cloud cover, both of which reinforce increases in the temperature of the Arctic troposphere. In the first part of the talk I review the mechanisms controlling the seasonal energy budgets of the Arctic atmosphere and ocean under current conditions and discuss feedback mechanisms, such as those mentioned above, that affect summer and winter conditions. In the second part of the talk I present some results from our studies of the Arctic Ocean and from coupled climate models. I finish with a discussion of some of the changes in Arctic atmospheric and oceanic climate we may expect in the next two centuries.

Burgers Board

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